Oak Decline Report

End of Season Summary

Abstract

Oak decline is a phenomenon where oak trees, both red and white oaks, are dying in large numbers in urban and developed areas. The causes, of which there are several factors, are not well understood. This has been reported throughout the Mid-Atlantic Region and is of increasing concern with forest managers, arborists, land managers and homeowners. The concern in this study, revolves around the impact oak decline is having on the County's reforestation efforts and tree canopy protection. Oaks are a major component of the forest types in this county and are the most valuable in terms of wildlife habitat and water quality. An estimated 23.4 acres of tree canopy was lost in the three years the study was open. Sandy and well-drained soil types were found on many of the sites indicating moisture stress was a significant stressor of the oaks that died. Extremes in weather conditions in terms of periods of drought and excess precipitation are also presented.

Keywords: Oak Decline, Climate Change,

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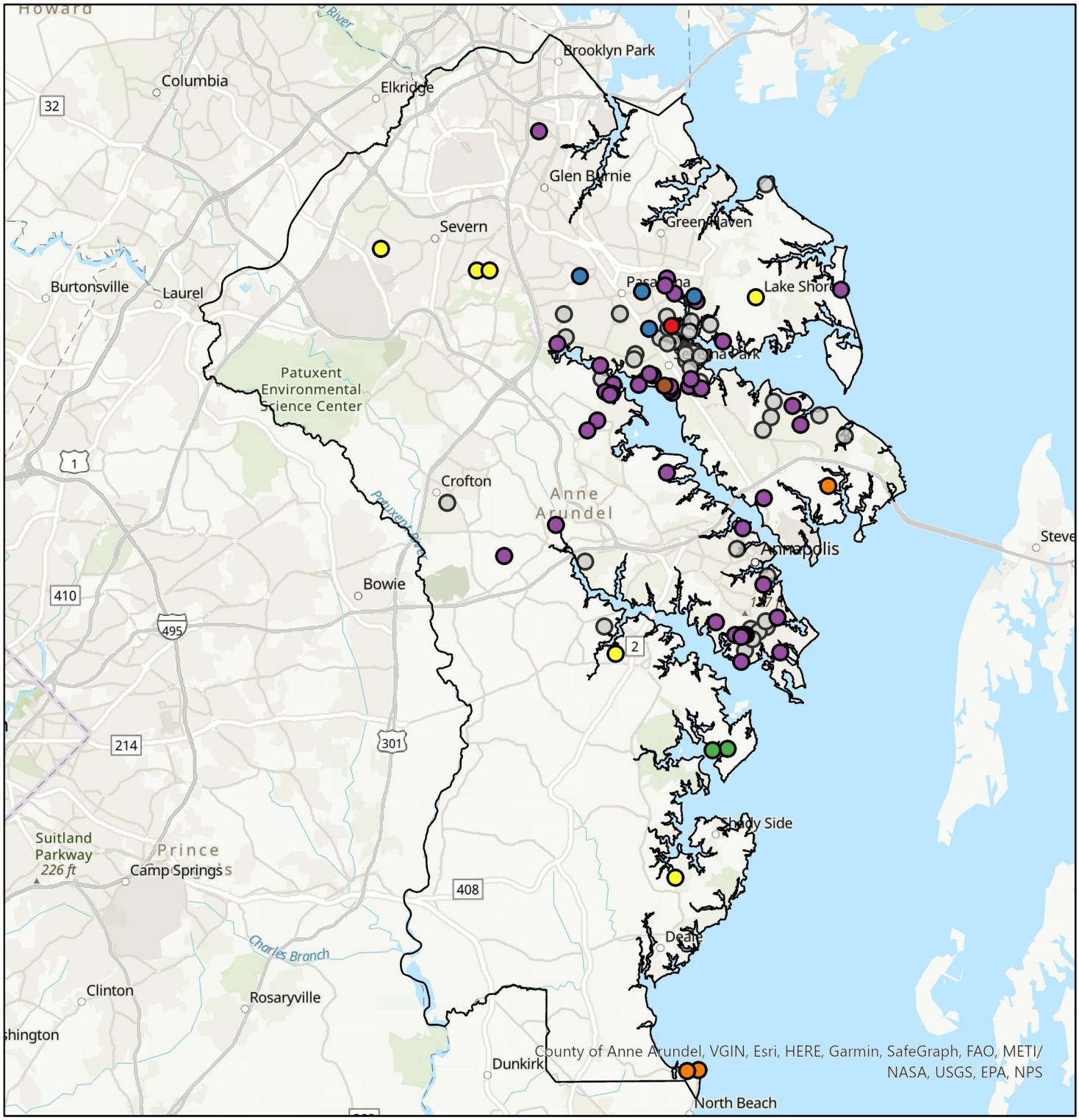
Earl "Bud" Reaves, CF
ipreav00@aacounty.org

Oak Decline Reports 2020-2022



Legend

Drainage Class

- Excessively drained
- Somewhat excessively drained
- Moderately well drained
- Well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- No Drainage Class
- County Boundary

0 1.5 3 6 9 12 Miles

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Introduction

Oak decline is a phenomenon where oak trees (*Quercus sp*.), both red and white oaks, are dying in large numbers in urban and developed areas. The causes, of which there are many factors, are not all well understood. This has been reported throughout the Mid-Atlantic Region and is of increasing concern with forest managers and arborists. An article by University of Maryland Extension documented this in 2019 (Gill, Rane, Clement, 2019). Another concern is the impact oak decline is having on the County's efforts regarding reforestation and protecting tree canopy coverage. Oaks are especially significant in that they are a major component of the numerous forest types in this county and are the most valuable in terms of wildlife habitat and water quality.

Subsequently, Anne Arundel County Forester Earl D. Reaves Jr. requested help from the Office of Information Technology's GIS group (OITGIS) for help tracking the location data to monitor the decline. In doing so, it was hoped areas could be identified and possibly treated before the problem becomes unmanageable. The program consisted of a webpage on the Anne Arundel County Inspections and Permits Department (I&P) website where residents could submit information on any oak trees they believed were in decline. In addition to their location, details on the number, size, proximity, soil conditions, and subgenus were also collected. A screen shot of the webpage is attached as Appendix A. The data collected would be added to an ArcGIS map within the attribute table and visually represented as a point where the decline was occurring. ArcGIS mapping of the decline sites allowed for enhanced report tracking and for spatial comparisons of decline hotspots.

Oak Decline Submissions

Public Response

The project was opened to the public on July 11, 2020. Submissions were continuous, with an initial surge at launch and a larger surge following a mention in the Severna Park HOA newsletter near the end of October. The program was suspended on November 12th as most oaks had begun to shed their leaves and identification became difficult. Overall, 81 reports were received identifying 421 individual trees. The program was open for four months with minimal public outreach.

In addition, several sites were recorded that had been observed in the field but were not documented by the webpage. Several sites where large numbers of trees were reported were also field checked and more precise data and observations were collected. These more precise data points were added to the data sets.

Analysis & Methodology

The reports generated by the public were mostly located in four areas: Annapolis, Severna Park, Crownsville, and Pasadena. Scattered reports came from other parts of the county. The species of oak trees that were reported, were evenly split between the red and the white oak families. Some form submissions reported the species as unknown either due to an inability to identify the species, or a lack of bark and other identifying features. A synopsis of the data collected on the webpage in 2020 is included in the report Oak Decline annual Report 2020 compiled by OITGIS, (Appendix B)

One of the main goals of collecting this data was to estimate the tree canopy lost by the death of these oak trees. Tree canopy coverage within a given jurisdiction or area is important due to the environmental and social benefits it provides to urban areas. Improved wildlife habitat, stormwater management, air quality, etc. are just some of the areas where tree canopy provides enhancement of these ecosystem services.

Estimating canopy diameter in square feet from diameter in inches at breast height (4.5') has not been studied in urban settings. However, it has been studied in forest stands which provides a reasonable estimate of the relationship. The closest study geographically and in the same forest types was from a study published by Neil I. Lamson in 1987 (Lamson, 1987). The paper presented a linear regression equation that estimated crown diameter for several commonly found species of trees, including oaks, in mixed hardwood forests.

The equation is: crown diameter = a + b(d.b.h.) with a and b the slope intercepts. The intercepts, standard deviation and standard error for white ash/oaks which were statistically similar was:

White ash/ oak group: a) 13.571 b) 1.318 std. dev. 0.59 std. error 0.768

Using this equation, an Excel spread sheet was created to calculate the crown diameter. For trees where the diameter was field measured, that figure was used for calculating the crown diameter, for those

trees where the crown diameter was estimated and compiled for each size class, both the highest figure and an average diameter for the size class was used for determination and comparison. For the largest size class: 30" and greater, the value of 30" was used for calculations unless the tree had been hand measured in the field.

Discussion and observations

2020

The oak decline app was taken down from the I&P website at the end of October. A total of 84 reports were made by residents and staff of Anne Arundel County. Reports were received from 8 areas of the county in approximately 10 zip codes. Most reports were of single oaks or small numbers of oaks ranging from 2 to 6 trees. Twelve reports were submitted that identified 9 to as many as 100 dead oaks. Three of the larger reporting sites: Downs Park, a private parcel off Long Point Rd, and an area of community open space in Annapolis at Annapolis Roads were visited to gather more detailed data and observations. Diameter to the nearest 1-inch size class was measured at diameter at breast height (DBH and observations were made to note any evidence of disease or injury. The geographic location was also recorded for each individual tree with a Garmin 64st handheld GPS unit. The locations were then downloaded and inserted into Geocortex as a shape file. The dead oaks located on the maps were then queried to determine the mapped soil type.

Downs Park

An inventory of the dead oak trees in Downs Park was conducted in Spring and early Summer of 2021. Notably, most of the dead oaks were in close proximity to the paved trail. This trail was recently repaved in a capital project in 2019. One of the methods used to prevent roots from buckling the new pavement was root pruning. This can cause stress in a tree due to the severing of roots which can lead to a decline in health. In addition, higher than normal amounts of precipitation has occurred over the last several years and ponding has occurred in many areas of the park. This also stresses trees, even those species adapted to wetland environments if the soil saturation exceeds several weeks. The soil types mapped in the location was Fallsington sandy loam (FaaA), a hydric soil that is poorly drained, indicating wetland conditions, and Patapsco-Fort Mott Complex (PfB) a somewhat excessively drained soil that's 92% sand. Because of those factors it is not surprising to see oak mortality on this site. A map of the locations of the dead trees is presented in Map B.

Annapolis Roads

A total of 90 dead oak trees were recorded in the community open space at the Annapolis Roads site. This site is bordered on the North by the Key Schools recreation area and on the South by Ogleton road. The parcel consists of 31.75 acres, the majority of which is forested. Dominant tree species noted include chestnut oak, white oak, yellow-poplar, sweetgum, and southern red oak. Other associated species include northern red oak, hickory sp., and red maple. Understory and shrub species were primarily mountain laurel, paw paw, and lowbush blueberry.

Most of the dead oaks (85%) found in this examination were chestnut oak, *Quercus montana.* Chestnut oak is a very common tree species in the forests of Anne Arundel County as well as the coastal plain areas of Maryland. A valuable timber tree, it is equally valuable for its seed production. Chestnut oak acorns are large and provide a valuable food source for many wildlife species. In addition, it is also a prolific seed producer (mast), producing both large quantities of acorns on an erratic basis, and large mast crops every 5 years on average (Burns, Hankal, 1990).

The attached maps (C-East, C-West) displays the locations of the dead oak trees tallied for this property. The markers indicate that the trees died in clusters in the stands. This indicates that site factors such as soil type, slope position, and density of the trees influenced the mortality of those trees. Micro site conditions can have a large influence on tree growth and mortality. For example, minor differences in topography can provide a moister or drier site for an individual tree. Soil data was layered on the map to determine the soil types these trees were growing on. Two soil series were identified: Annapolis sandy loam, on various slopes of 2 – 40%, and Annapolis-Urban land complex on 5-15% slopes. These soils are all considered well drained. The depth to the water table is 201 feet. These soils consist of, on average, 66.8 to 82.3% sand. Standing water is rarely, if ever, found on sites associated with these soils but they are very susceptible to drought conditions.

A forest stewardship plan was written for the Annapolis Roads Community open space in May 2020 by MD Department of Natural Resources Forest Service Project Forester Justin Arsenault (J. Arsenault, personal communication, July, 2021). Stand data was collected and compiled and summarized for each stand. There are two clusters of oak mortality located in Stand 3, with the remaining six clusters located in Stand 2. Stand 3 is identified as an even age mixed hardwoods with the dominant species listed as red maple, yellow-poplar and sweetgum. Oaks and other species are associates. This stand is quite dense, noted to be overstocked at 107% with an average basal area of 93 ft^2 and 127 trees per

acre. Virginia pine, a component of this stand and likely the pioneer species that was the dominant species when the stand first developed, is rapidly dropping out of the canopy as they have reached maturity and are dying. This is a natural process as the pine(s) in such stands begin the successional process by forming a canopy and getting the forest floor established. Hardwood species such as yellow-poplar regularly become established at the same time and are able to outcompete the pines because of their rapid growth rate. Oaks and other more shade tolerant species gradually enter the stand and grow as co-dominants taking advantage of canopy gaps when the pines drop out leaving space for them to grow.

This process appears to be well underway as many pine trees have died and fallen. These dead and dying pines have the effect of thinning the forest, reducing the density and improving growth conditions. The dead trees also provide gaps in the canopy where advanced regeneration of the hardwood species, such as oaks, hickory and yellow-poplar, can occur. This is the natural order of succession and is not cause for worry.

The decline of the oaks at the same time is of concern however, as there is potential for larger gaps in the canopy to form that can be detrimental to stand health and dynamics. These larger than usual gaps can allow too much light to reach the forest floor leading invasive vines and other plants to become established which can severely hinder the advanced reproduction. Invasive vines such as Asian bittersweet and Japanese honeysuckle will strangle and cover tree seedlings, killing them outright or preventing them from becoming established. The understory trees and shrubs normally found in these areas can also succumb to the vines, suppressing the shrub and understory layers crucial to forest health and diversity.

In the Annapolis Roads community recreation and open space area, the oaks that have died were growing mostly in clusters. Two large clusters, one of 22 trees and a larger one of 36 trees were identified via Geocortex, the County GIS application. These dead clusters in the forest have opened large gaps that are currently seeding in with invasive species. A map of the locations of the dead trees is presented in Map C - C.

Long Point Road Community

On a private property off of Long Point Road, numerous dead trees were observed from the road. The property was located and permission to measure the trees was obtained from the homeowner. Twenty three dead oaks, mostly chestnut oak but interspersed with white oak, were found growing in a

depressed area of the property. The trees were measured; however, the data sheet cannot be located. The dead trees were all over 20" in diameter at DBH, and had strong crowns. Measurement of the canopy on Geocortex revealed an area of 0.42 acres of approximate canopy area was lost due to the mortality. This was not added to calculations due to the loss of the data. Soil type identified via Web Soil Survey was Evesboro-Galestown-Urban land complex. A map of the locations of the dead trees is presented in Map D

2021

The Oak Decline reporting app was taken off the I&P webpage at the end of November, 2021. Twenty one reports were received from twelve different Zip codes, all in the northern half of the county. Approximately 114 trees were reported but did not include trees on adjacent properties. Many reports said there were dead oak on adjacent properties. Of those reported half of the trees reported were in the red oak family with less than half in the white oak family with several unknown. Two site visits were made to Shipley's Choice Park to make detailed observations. A map of the findings is presented in Map E.

Shipley's Choice Park

Shipley's Choice Park is a small community park located in Severna Park off of Governor Stone Parkway. Shipley's Choice Park is adjacent to Shipley's Choice elementary school. One stand of mixed oaks and pine on the southern boundary experienced multiple oaks in decline with most dead. Each declining tree was measured, located on a handheld GPS and noted for observations of disease or insect pests. In this stand, interestingly, there were numerous pines that had also died. These pines were not included in the inventory. Forty oak trees were tallied in the area experiencing oak decline with an average diameter at breast height (DBH) of 16.5" DBH. The diameters ranged from 10" to 31" DBH with a median value of 17. Soil type identified via Web Soil Survey was Evesboro-Galestown-Urban land complex. The same soil type found in the Long Point Road site. The total basal area represented by the 40 dead oaks was 59 square feet. The mortality of the large trees in this area of the stand was almost total. There was some regeneration established that can potentially replace those trees lost. Monitoring the site to keep track of the regeneration and its status is recommended as it is possible the stand can regenerate itself into a healthy stand of oaks. Invasive vines will need to be controlled to

ensure that any advance regeneration present, is able to survive. Volunteers (Anne Arundel Weed Resistance, 2019) could assist, and if they start before the site gets overwhelmed with vines and herbaceous weeds, they will be able to control the invasives sufficiently to ensure survival. A map of the locations of the dead trees is presented in Map E

The reports received in 2021 were very similar to those that were reported the previous year. The number of reports were much smaller and that is attributable to a lack of outreach. As noted in 2020, most of the reports were from the central part of the county with very few from the southern areas below Annapolis, and the far northern and western regions.

2022

Several sites were visited during the 2022 season to verify and document oak mortality. One site was on private property in the Arnold, Maryland area on Shore Acres Road. Six trees were reported but after visiting the site, a total of twenty six dead oaks were found on this and an adjoining property. 23 (88%) of these were chestnut oak, with two black oaks and one southern red oak also noted. The average diameter of the trees recorded was determined to be 21" DBH. Using the Lamson formula, this represented 0.79 acres of canopy loss. The soil types noted on these properties were mapped as Annapolis loamy sand, Collington and Annapolis soils, both described as well drained. There were numerous dead oaks that were on adjacent properties as well. See Map F.

General Discussion 2020-2022

A total of 120 reports were received on the Oak Decline app during the three seasons it was posted. Approximately 611 trees were reported as dead or dying. This is likely a fraction of the actual number of oak deaths within the County due to a lack of reports from several areas in the county. Many individual oaks probably died in areas where their death wasn't noticed by residents or if observed were not cause for concern as they posed no threat to life or property. The causes of their death varied. Diseases that were observed included Hypoxylon canker, *Biscogniauxia (Hypoxylon) atropunctatum*, and Bacterial leaf scorch, *Xylella fastidiosa.* These disease organisms are widespread throughout the area and because of their nature, cannot be treated with pesticides. Bacterial leaf scorch, an exotic pathogen, can attack healthy trees. Spread by leaf hoppers, Bacterial leaf scorch infects the leaves and spreads to the twigs and eventually the mainstem of the tree. Treatments with antibiotics

will stop the symptoms but will not cure bacterial leaf scorch. Hypoxylon canker is a native disease that also infects healthy trees. However, it doesn't kill trees unless they are under stress. Once the disease process starts for both pathogens, they cannot be cured.

Oak wilt (UMD Extension, 2019) is another disease that has gotten a lot of attention recently. Caused by the fungus, *Bretziella fagacearum* (formerly *Ceratocystis fagacearum*), Oak wilt is a systemic disease that invades the sap wood, or water conducting tissues of the tree. The fungus clogs the sapwood causing the leaves to wilt from lack of water. Oak wilt has not been detected in Anne Arundel County. It has been found in Maryland, mostly in the western counties. Currently, there is no cure for the disease. All oaks, both the red and white oak families are susceptible, although white oaks are somewhat resistant. The disease spreads by root grafts and by sucking insects that transfer the spores to new trees. Should it become established in Anne Arundel County it will cause significant mortality of oaks.

Other stressors are weather related. Periods of drought and then stretches of excess precipitation can severely stress trees. Healthy growth in a tree can be curtailed by drought conditions by inhibiting uptake of nutrients and the loss of leaves as the tree tries to compensate for the lack of moisture. Excess precipitation can also cause stress but in different ways. Abnormal rainfall can lead to flooding and ponding of water on the root systems of trees. Like all living tissue tree roots need oxygen to function. Trees can withstand ponded water for short periods of time, however if the ponding lasts for more than a couple of weeks, even wetland adapted trees can suffer severe mortality of the root system unless special root adaptations are present such as that found on Bald Cypress. Flooded conditions can also expose tree roots to pathogens such as *Phytophthora* root rot, a water mold or oomycete, caused by numerous species of *Phytophthora sp.*, which will attack the roots and weaken or kill the root system.

The sites where oak mortality was evaluated were compared with the soil types present as mapped by the NRCS Soil Survey. This comparison suggests that these events occurred where the oaks that died, were growing on soils that had well drained to excessive drainage or were on hydric soils which had poor drainage. The well drained to excessively drained soils have a high percentage of sand and do not retain moisture well during drought conditions. The water table in these soils is often six feet below the surface. The Downs Park site, was primarily located on a hydric soil - Fallsington series - which is

poorly drained. Ponding occurred on this site that lasted for several weeks as observed by Park staff. As noted before, even wetland adapted trees cannot withstand long periods of inundation. This indicates that precipitation, either a lack of, or in excess for long periods of time is strongly tied to the amount of mortality observed. Weather data confirms this.

Weather Data

Chart A depicts the monthly totals of precipitation that was recorded at the Baltimore weather station located at BWI Airport in northern Anne Arundel County (Climate Indicators, EPA). What the chart reveals is that from the period of 2010 to the present, seven of those twelve years were periods of drought while four of those years were periods of excessive rainfall. During the period of 2016 through 2021, there were two years of above average precipitation averaging 17.02 inches above normal. There were three years when precipitation was below normal, averaging 7.72 inches below normal. This up and down cycle of drought and excess precipitation as noted before puts stress on trees and seems to be the most apparent stressor connected to the oak decline reported throughout the County.

In addition, looking at Chart A, during the active growing season of April through August, drought occurred on average eight of the twelve years. This is detrimental not only to tree growth and health, but also for seed production, as producing seed takes a considerable amount of energy and water. Poor seed crops have negative effects on general forest health as well in terms of advance regeneration, and adverse effects on wildlife that depend on oak seeds or acorns for food.

Discussion

The reports received represent a small fraction of the total number of oak trees that have died in the past few years. Most of the trees reported were located within areas that were well developed and the residents reporting the tree loss were for the most part, only reporting trees that died on their property. It is not reasonable or appropriate to project or estimate the number of trees that died in unreported parts of the county as such projections would be speculative. It is probable, however, that similar numbers of oak deaths are occurring there as well, as weather conditions are the same in those areas as that found on the reported sites. It is also likely the loss of tree canopy would be similar as well.

The ramifications of this loss of oak trees is significant. Oaks are a keystone species in many forest types found in Anne Arundel County. They provide crucial habitat to a wide variety of wildlife species including pollinators. They also represent significant economic opportunities for landowners wishing to manage their forest lands for timber harvests. Oaks also provide other ecosystem services in terms of water quality, erosion control and producing oxygen, to name a few.

Canopy Loss

Based on the formula provided by Lamson discussed on page 2, a conservative estimate of the amount of canopy lost in the years 2020 through 2021 indicate a total of 23.4 acres of lost tree canopy. Table 1 below, illustrated average values of the size categories, respectively 12", 23", and 30", and the canopy estimate for each. (Table 1)

Estimated Canopy Loss 2020 - 2022				
Diameter Class	**#**	**Canopy area per tree\ft²**	**Sub-totals\ft²**	**Totals**
<= 15" (8)	68	456	31,008	
16" - 30" (23)	307	1,512	464,184	
30"> (30)	236	2,215	522,740	
	611			
			Total Square feet	1,017,932
			Estimated Total Acres	23.4

Table 1 Estimated Canopy Loss per Diameter Class

The distribution of tree loss was concentrated in the middle size class of trees 15 – 30" DBH. This is consistent with normal natural thinning of forest stands. That size class of trees is transitioning from a rapidly growing stand of immature sawtimber size (15 -24" DBH) to mature timber (24 – 30"DBH). Competition is high in these stands as the trees compete for finite resources. Stands in this stage are said to be entering the complex stage of succession, where mortality causes gaps in the canopy, which are filled in by understory and advance regeneration of existing canopy trees. This starts the process of transitioning to an uneven aged forest.

In many cases though, the gaps created by the mortality of oaks is larger than normal and can lead to infestation by invasive trees (Callery pear, Ailanthus), shrubs (privets, autumn olive, etc.) and vines (Asian bittersweet, Wisteria, sp.).

Canopy Loss on Study Sites		
Site Name	**Ownership**	**Area\Acres**
Annapolis Roads	Private	3.1
Shipley's Choice Park	Public	0.9
Downs Park	Public	1.2
Shore Acres	Private	0.8
Bay Park Way	Private	0.3
		6.3

Table 2 Estimated canopy loss on Select study sites

Table 2 above shows the estimated canopy loss on the areas that were ground truthed and data collected.

Recommendations

Climate change has increased the severity of storms and increased the duration of drought conditions throughout the United States. The Mid-Atlantic States are not excluded from these effects and will continue as climate change unfolds. Actions that may help oaks and other species of trees survive the effects are limited. Watering of trees is impractical in forested areas but can be used to help individual high value trees such as shade trees. There are no pesticides that will protect trees from infection by the pathogens listed previously. However, silvicultural methods can be applied, including thinning of overstory trees, so the remaining trees have sufficient room to grow. As noted before, trees require a specific quantity of space to grow that is dependent relative to diameter, as they compete for moisture and nutrients. This is referred to as the stocking level, or density in Forestry (Ginrich, 1967)[3] Manipulating or adjusting the stocking level by removing or harvesting trees in any given stand of trees is a cornerstone of silviculture. This is most often used to improve the growth rate of the trees being managed which translates into healthier trees. These practices, of which there are many methods, also allow foresters to maintain or enhance forest health. To determine the stocking level in a stand, two

specific measurements need to be determined, the basal area per acre/hectare, and the number of trees per acre/hectare. For the first, the diameters of the individual trees are converted into a spatial quantity where it is expressed in square feet or square meters. This metric is known as basal area. The sum of the basal area of all trees over 2" diameter in an acre or hectare of land is then calculated to determine the amount of basal area for that stand. The number of trees per acre is then calculated by either counting each tree over 2" diameter or by sampling methods. The two figures are then located on a chart to determine the relative stocking level for the stand.

The stocking levels appropriate for distinct species of trees or of forest associations have been well studied and are readily available as charts (B. Roach, S. Ginrich, 1968). An example of a central hardwoods stocking chart is attached as an appendix. The stocking level refers to the density in terms of number of trees and diameters where the stand can fully utilize the site for maximum growth. These levels are believed to apply in small woodlots or "urban" forests as much as they would in a rural forest. Identifying the stocking level in the forest experiencing oak decline and thinning out sufficient trees to bring it to a satisfactory density may be able to stop additional oaks from dying. The unknown factor is how much stress the trees have sustained up until then. Oaks that start declining may not be able to respond to thinning of the stand especially in older stands. Thinnings are usually accomplished through a commercial harvest where the trees to be thinned are cut and sold for wood products, or non-commercially, where the trees thinned are cut or sometimes girdled to kill the tree to be thinned and left in the forest for wildlife habitat or used by the landowner for firewood.

There is, however, no practical way to thin trees in most urban forests. The expense of removing trees in urban settings is also a significant factor as well. Proximity to homes and other structures often requires trees to be taken down individually to prevent damage to property and not cut and dropped as they would during a normal harvest operation. The removal of trees, portions at a time, and often using cranes and other equipment to prevent damage to life and property increases the costs of tree removal.

This mortality of oaks we are experiencing, reminiscent of the earlier outbreaks of the Spongy Moth (formerly Gypsy moth), *Lymantria dispar* and the Emerald ash borer, *Agrilus planipennis*, illustrates how tree canopy loss is also exacerbated by forest pests and diseases. Forests are not static and are changing every day imperceptibly to the observer. As they mature, they will experience natural mortality of the trees that succumb to competition. They are also vulnerable to the effects climate

change is bringing to the table as well. It is reasonable to assume that this will continue over the next decades and may become worse depending on how extreme the weather patterns become.

The effects of urbanization in our forests are also of note. Most of the reports of oak decline in the years 2020 through 2022 occurred in urbanized areas. The added stresses an urban setting has on trees is still being studied but from what we know already, the stressors are there and many, including air pollution, poor landscape maintenance, and soil compaction to name a few. Construction around trees must be done more carefully to minimize the effects and better maintenance and care of existing trees in the urban forest must be undertaken. Construction damage to trees can take many years to become noticeable.

Tree Planting Considerations

With oak decline being talked about recently, there are many questions being asked about the sustainability of oak forests and whether or not oaks should be planted in restoration planting and landscapes. The answer is yes. The mortality we have been experiencing with oaks has been related to stress on the trees from their environment. Oaks that are planted or in naturally occurring stands, and maintained in healthy conditions should not have a problem growing to maturity. As a keystone species, oaks of all species should be encouraged, especial white oaks which have been facing challenges (White Oak Initiative, 2023). Replanting oaks in gaps caused by the death of oaks previously occupying these sites should also be considered. In some cases, existing regeneration may be adequate and can be encouraged by controlling invasive vines and other plants that could strangle the young trees or shade them out. Maintenance of the site will be crucial to keep these aggressive plants from returning. Good species selection is important as well. When planting trees, the key is to match the tree and its growth habits with the existing site conditions regarding moisture regime and available light. For example, planting pin oak or swamp white oak on wet sites and upland oaks such as black or chestnut oak on dry sites will yield better results.

The presence of Oak decline will continue to occur in Anne Arundel County for the foreseeable future. Climate change with the extreme cycles of drought and excess precipitation will continue to plague the area, and overcrowding will be present in many forest stands within the County. Active management

of forest land and careful attention to tree health and maintenance will be crucial to managing this phenomenon.

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Appendix I

Glossary of Terms

Definitions of select terminology were obtained from Maryland State Forest Conservation Act Technical Manual, 1997; University of New Hampshire Extension; Society of American Foresters (SAF), Dictionary of Forestry, 1998.

Advanced Regeneration - Seedlings or saplings established naturally without the influence of harvesting under a forest canopy are called advanced regeneration. Often it will determine what species will regenerate.

Basal Area - the total cross sectional area of a tree(s), per unit area expressed in square feet. May be measured using a variable plot method such as a basal area factor prism, or may be calculated from the DBH of all trees within a fixed area plot.

Critical Root Zone - a circular region measured outward from a tree trunk representing the area of the roots that must be maintained or protected for the tree's survival. Critical Root zone is measured as one foot of radial distance for every inch of tree diameter (DBH) measured at 4.5 feet above the ground, with a minimum radius of 8 feet. For specimen trees the critical root zone shall be 1.5 feet for every inch of tree diameter.

Diameter Breast height – d.b.h; standard height used to measure trees, measured at 4.5' above ground.

Erodible Soils - Soils with a K value of .35 or greater on slopes of 15 percent or greater

Forest (MD FCA) - a biological community dominated by trees and other woody plants covering a land area of 10,000 square feet or greater. Forest includes:

> (1) areas that have at least 100 trees per acre with at least 50% of those having a two-inch or greater diameter at 4.5 feet above the ground and larger, and
>
> (2) forest areas that have been cut but not cleared. Forest does not include orchards.

Forest (SAF) – an ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stand varying in characteristic such as specie composition, structure, age class, and associated processes.

Forest Stand -- a forest stand is a contiguous community of trees sufficiently uniform in composition, structure, age and size class distribution, spatial arrangement, site quality, condition, or location to distinguish it from adjacent communities, a contiguous group of trees sufficiently uniform in species composition, arrangement, and age.

Forest Structure - Forest structure is the horizontal and vertical distribution of layers in a forest including the trees, shrubs, and ground cover (which includes vegetation and dead and down woody material). Structure looks at the proportion of small, medium, and large trees and is usually reported as trees per acre by diameter class.

Shrub - a woody plant smaller than a tree, usually having multiple permanent stems branching from or near the ground. Less than 20 feet tall.

Specimen Tree – trees that are 30" d.b.h or larger. Or, within 75% of the diameter of the State or County Champion tree of that species.

Tree - a large, branched, woody plant having one or several self-supporting stems or trunks that reach a height of at least 20 feet at maturity.

Understory Trees - trees with crowns entirely below the general level of the canopy receiving little or no sunlight from above or the sides. May grow up to 40 feet tall at maturity.

Appendix A

Reporting Page - Oak Decline

# of Dead Trees

Are they contiguous (crowns touching) or scattered in the landscape/woods?

Contiguous

Oak Family: There are two families: white oaks and red oaks. White oaks have smooth leaf edges or margins. Red oaks have bristle tips at the end of the lobes. If not oak trees or unknown leave bank and attach photos.

Oak Family

Red Oak

What species (if known): Several phone apps allow the user to submit a photo and obtain an ID, Or If not known take a photo of the bark and leaves\twigs and attach below.

Site Conditions: forest area, forest edge, swampy area, dry site such as a hilltop, lawn area, etc. be descriptive.

Site Conditions

Dry

Size:
15: DBH or smaller
16 -30" DB
30" or larger

DBH or Diameter at Breast Height is measured at 4.5" from the base of the tree. DBH is the standard place to measure trees worldwide. An easy way is to get the circumference with a tape measure and divide by pi or 3.14

Size

15 inch DBH (Diameter at Breast Height) or smaller

Upload Photo: take a photo of the trees from a distance and an up close photo of the bark, leaves=twigs.

Downs Park Oak Decline - Map B

Legend

DpWP1
1

points
1

Downs Park Trail

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

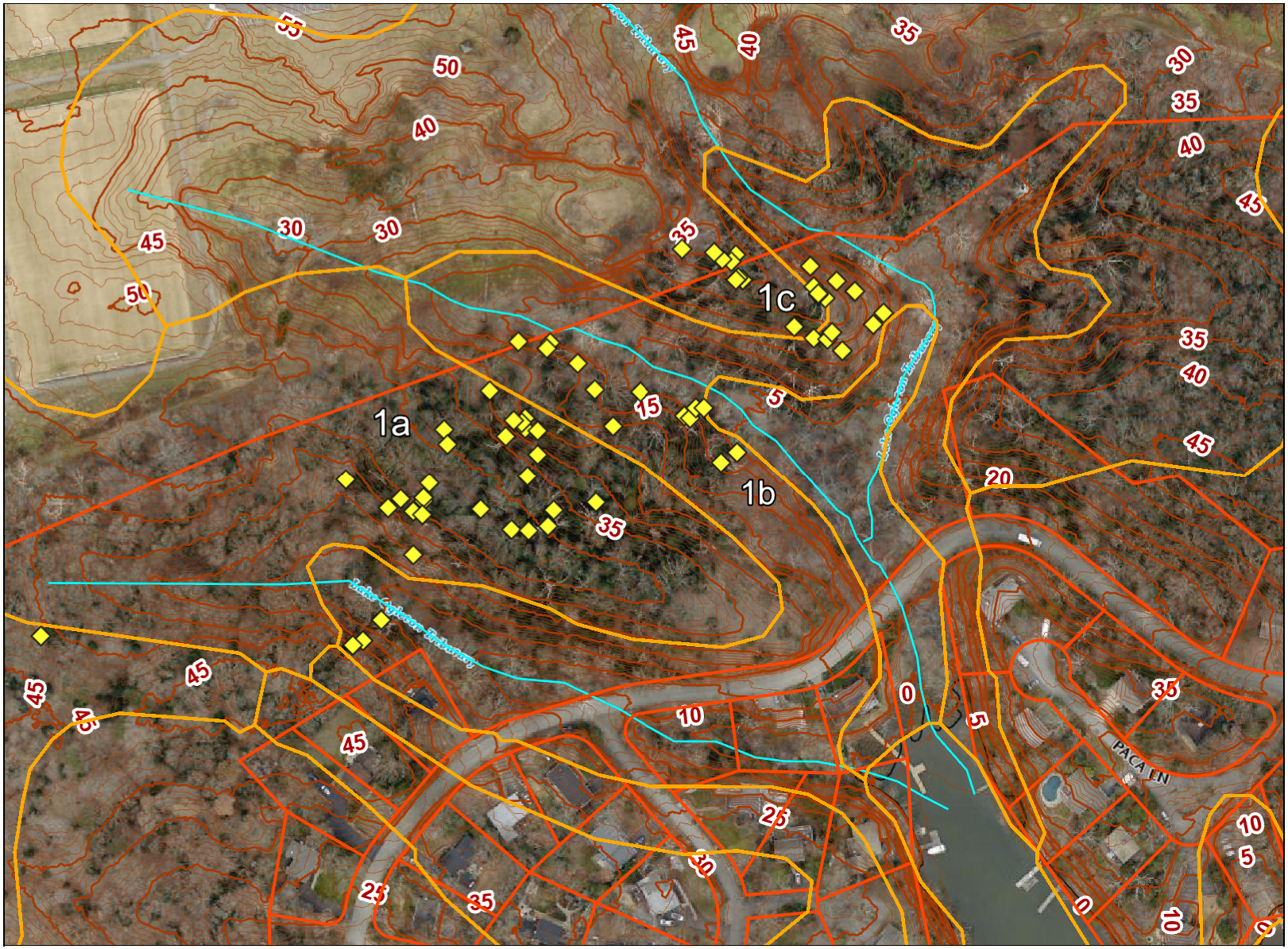
0 500 1000 ft

MD iMAP, The U.S. Department of Agriculture, Natural Resources Conservation Service, should be acknowledged as the data source in products derived from these data.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Notes Dead oaks marked with Yellow X

Annapolis Roads - Oak Decline Map C -East



Legend

AnnapolisRoads
1

Planning: Parcels
Parcels

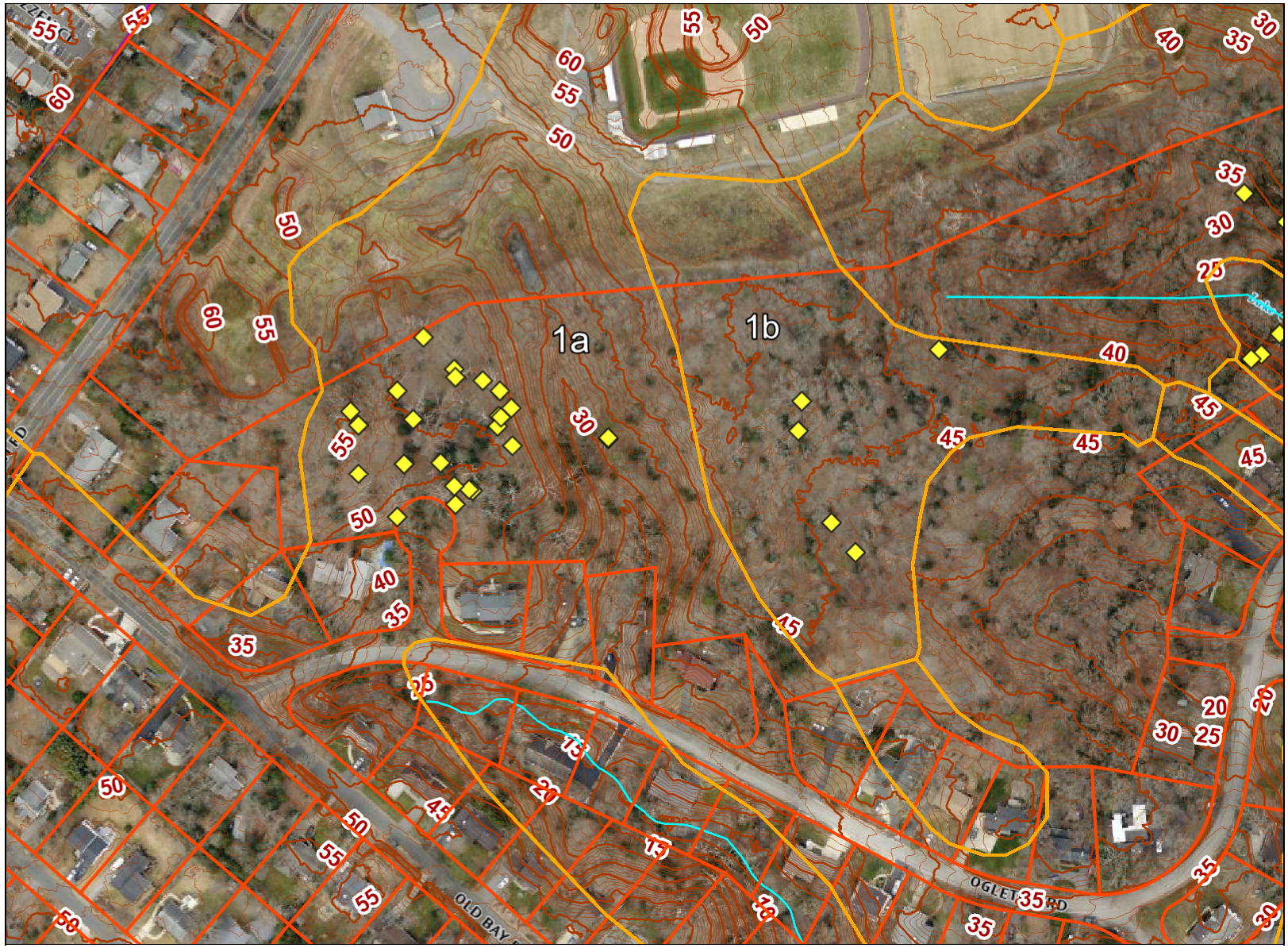
Environment
Perennial Streams
Intermittent and Ephemeral Streams

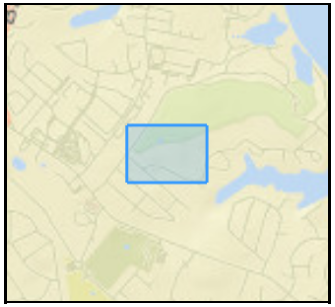
Elevation
Topo 2017
Index
Intermediate
Topo 2017 Labels

0 250 500 ft

Notes Dead oaks recorded on community property

Annapolis Roads - Oak Decline West Map C-West





Legend

AnnapolisRoads
1

Planning: Parcels
Parcels

Environment
Perennial Streams
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Elevation
Topo 2017
Index
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Topo 2017 Labels

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0 250 500 ft

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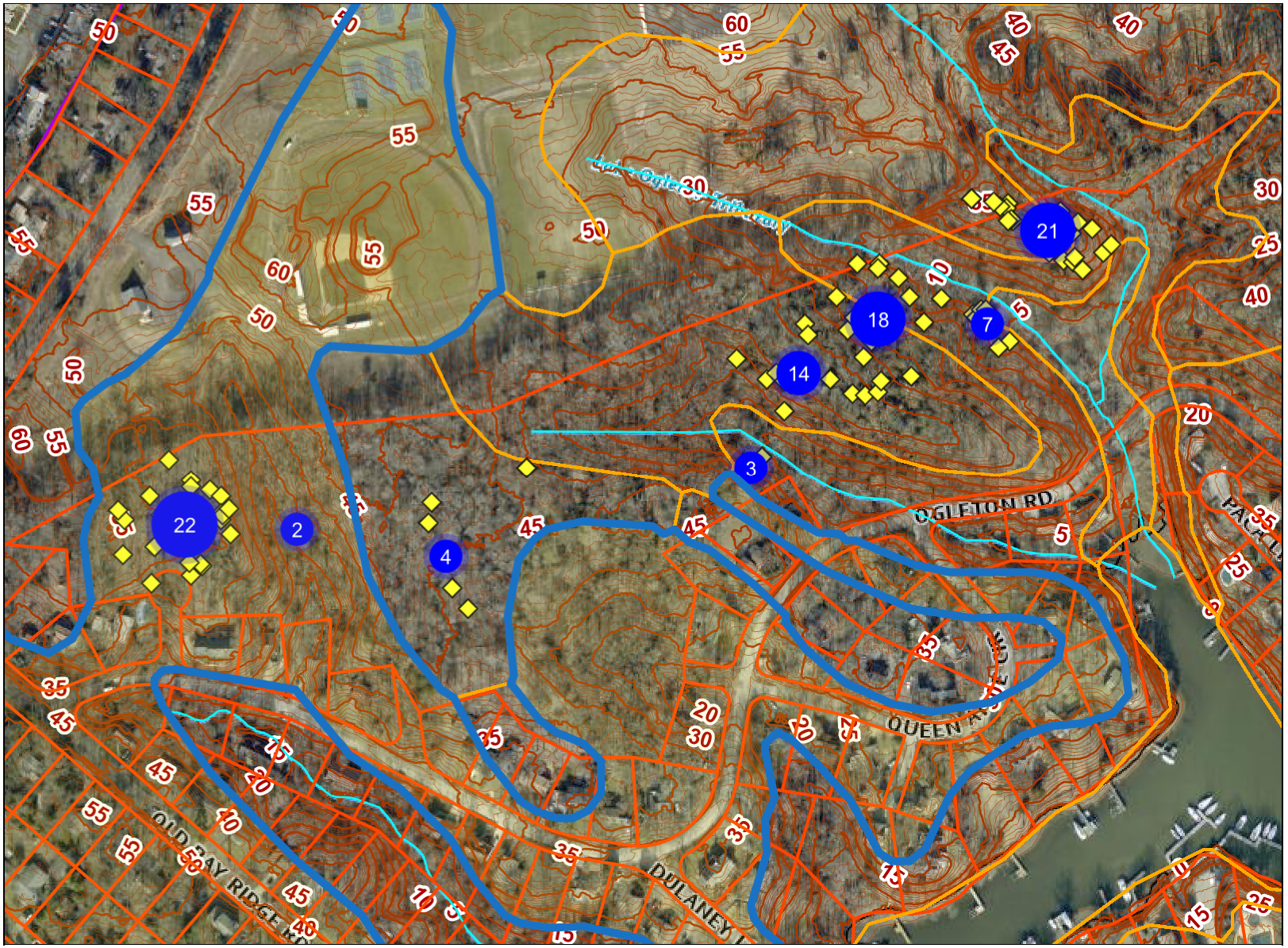
THIS MAP IS NOT TO BE USED FOR NAVIGATION

Notes Dead oaks recorded on community property

Annapolis Roads HOA Data Clusters



Legend

AnnapolisRoads
1
22+
15 - 21
8 - 14
2 - 7

AnnapolisRoads
1

Planning: Parcels
Parcels

Environment
Perennial Streams
Intermittent and Ephemeral Streams

Elevation
Topo 2017

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0 350 700 ft

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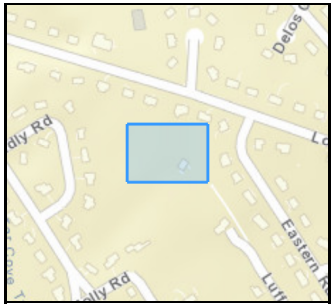
THIS MAP IS NOT TO BE USED FOR NAVIGATION

Notes

Long Point Road Oak Decline Site Map D



Legend

Luff Ct

Foundation

Parcels

Environment

Soils

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0 50 100 ft

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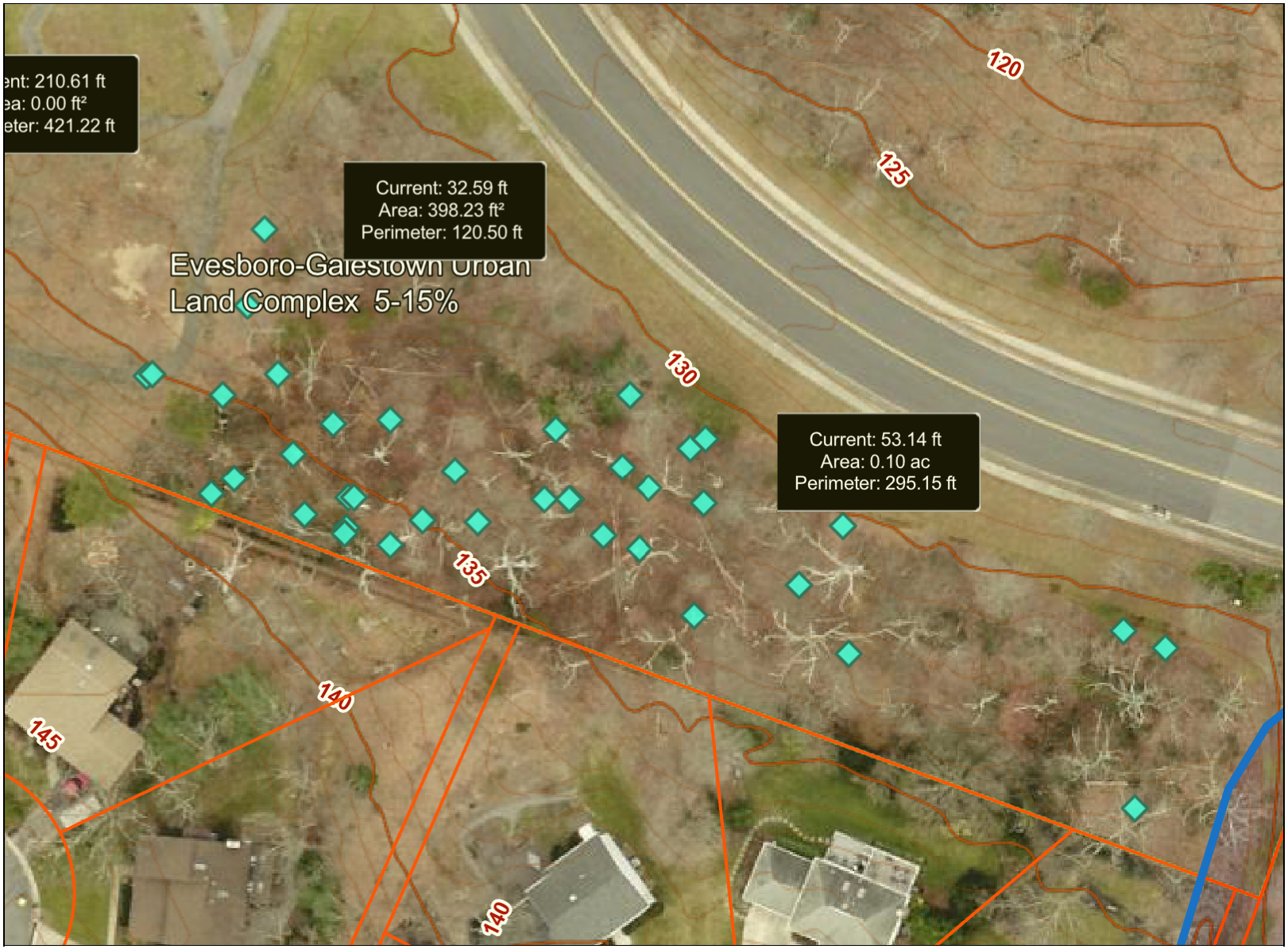
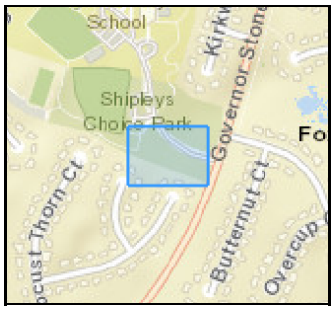
THIS MAP IS NOT TO BE USED FOR NAVIGATION

Notes

Shipley's Choice Park - Oak Decline Map E





Legend

ShipleysChoice
1

Planning: Parcels
Parcels

Environment
Perennial Streams
Intermittent and Ephemeral Streams

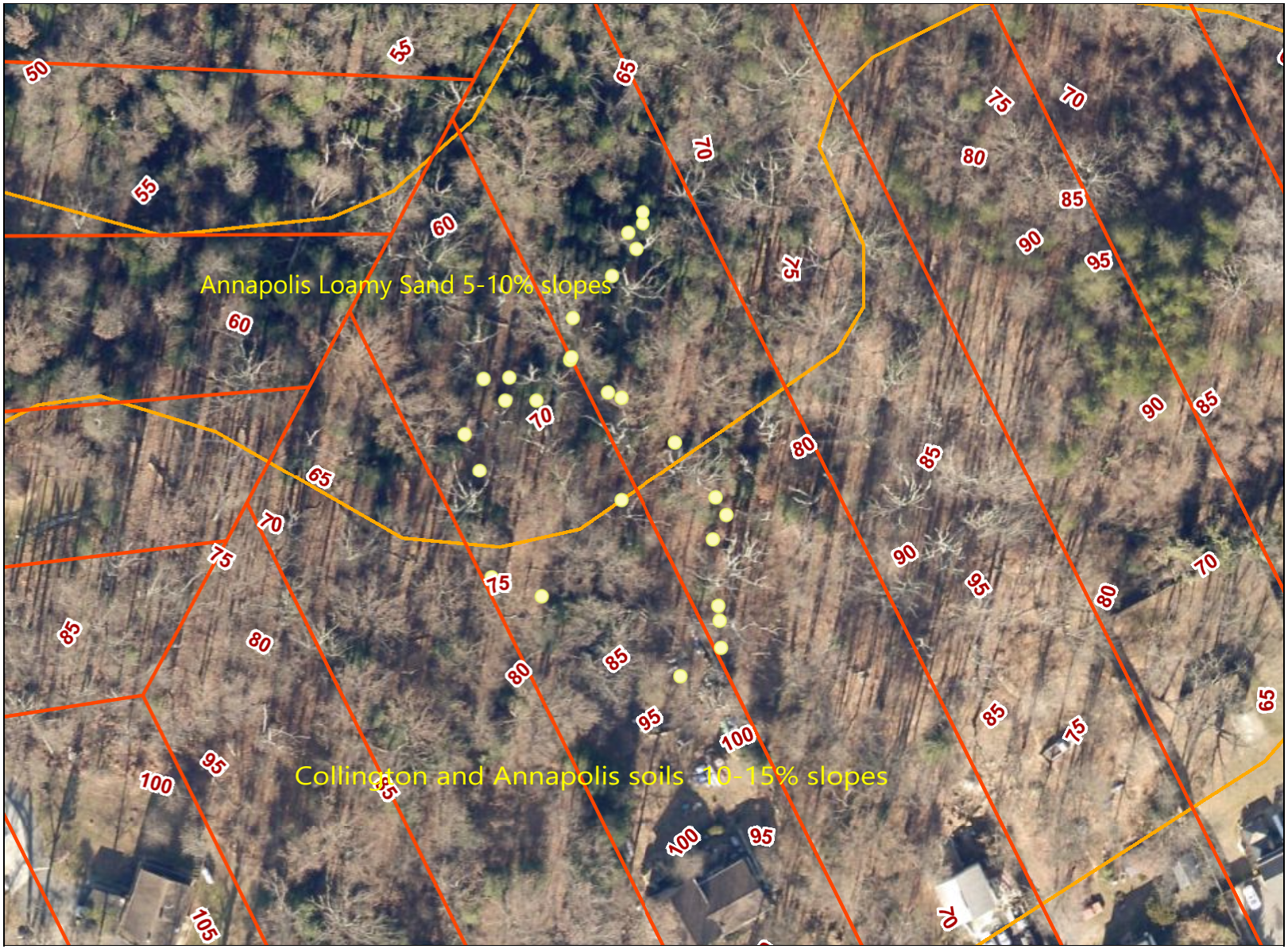
Elevation
Topo 2017 Labels

Topo 2020
Topo_2020

0 50 100 ft

Notes Entire site mapped as Eveboro- Galestown Urban Land Complex 5-15 % Slope.

Oak Decline Shore Acres Road Map F



Legend

Shore Acres

Dead oaks

Foundation

Parcels

Environment

Soils

soil boundaries

Elevation

Notes